

Appl. No. 10/022,398
Response to Office Action of Dec. 14, 2004

PATENT
Docket No.: FR000116
Customer No. 000024737

Amendment to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) An image processing method of detecting tag points in a current tagged image of a sequence of tagged images, comprising the steps of:

in the current image, estimating points which have optimal intensity values in intensity profiles and labeling said points as candidate points of a tag;

using a previously constructed predicted image constituted by predicted tags determined from tag equations of a preceding image of the sequence and from spatial and temporal parameters; and,

in the current image, detecting tag points among said candidate points from said previously constructed predicted image;

determining tag equations for the current image from said detected tag points;

and

using said tag equations in the construction of a further predicted image for processing a next image of the sequence, wherein detecting tag points from said previously constructed predicted image comprises:

distinguishing two kinds of tags: negative tags corresponding to minimum magnetization and to maximum intensity in the intensity profile, and positive tags corresponding to maximum magnetization and to minimum intensity in the intensity profile;

distinguishing two kinds of candidate points: candidate points being optimum value points corresponding to maximum intensity in the intensity profile, and candidate points being optimum value points corresponding to minimum intensity;

selecting points of a negative tag D as being the candidate points corresponding to the maximum intensity, which are situated between the two

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predicted positive tags surrounding the predicted negative tag that corresponds to the negative tag D, and
symmetrically selecting the points of a positive tag.

2. (Currently Amended) An image processing method as claimed in Claim 1, wherein ~~the step of determining tag equations from detected tag points uses~~ comprises using a rational least squares approximation to calculate the tag equations from the detected tag points, said rational least squares approximation being used alone or in combination with a further approximation ~~using a Residue Technique to locally compensate for error between a sample and the rational least squares approximation.~~

3. (Canceled).

4. (Currently Amended) An image processing method as claimed in claim 1, wherein the step of constructing a predicted image comprises ~~sub-steps of:~~

choosing a given number of privileged points on tags of the preceding image of the sequence;

calculating, from positions of said privileged points on, at least the preceding image of the sequence, a predicted position of said privileged points; and

constructing predicted tags of the predicted image from predicted positions of said privileged points.

5. (Currently Amended) An image processing method as claimed in Claim 4, wherein the step of constructing predicted tags from predicted positions of said privileged points comprises ~~sub-steps of:~~

estimating a function (f) that minimizes the distance between the predicted positions of privileged points and the result of the application of this function f to these privileged points; and

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applying said function (f) to tag equations of the preceding image of the sequence to construct the predicted tags of the predicted image.

6. (Currently Amended) An image processing method ~~as claimed in Claim 5~~ of detecting tag points in a current tagged image of a sequence of tagged images, comprising:

in the current image, estimating points which have optimal intensity values in intensity profiles and labeling said points as candidate points of a tag;

using a previously constructed predicted image constituted by predicted tags determined from tag equations of a preceding image of the sequence and from spatial and temporal parameters; and,

in the current image, detecting tag points among said candidate points from said previously constructed predicted image;

determining tag equations for the current image from said detected tag points; and

using said tag equations in the construction of a further predicted image for processing a next image of the sequence,

wherein constructing a predicted image comprises:

choosing a given number of privileged points on tags of the preceding image of the sequence;

calculating, from positions of said privileged points on, at least the preceding image of the sequence, a predicted position of said privileged points; and

constructing predicted tags of the predicted image from predicted positions of said privileged points,

wherein the step of constructing predicted tags from predicted positions of said privileged points comprises:

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estimating a function (f) that minimizes the distance between the predicted positions of privileged points and the result of the application of this function f to these privileged points; and
applying said function (f) to tag equations of the preceding image of the sequence to construct the predicted tags of the predicted image, and

wherein the function (f) is a similarity expressed as $f(z)=lz+c$, where l and c are complex parameters.

7. (Previously Presented) An image processing method as claimed in claim 4, wherein privileged points are intersections between tags obtained from an MRI image tagged in a grid pattern in two different directions or between tags obtained from two MRI images each tagged in a straight and parallel line pattern in one direction different from the tagging direction of the other, said two MRI images corresponding to a similar step of the sequence, said intersections being calculated based on the tag equations.

8. (Currently Amended) An image processing method of claim 1, to be applied to, at least, a sequence of MRI tagged images, to track tags on successive images of the sequence, comprising steps of:

initializing the processing method by implementing one of the methods of claim 1 for the first image of the sequence, using a first predicted image which represents the non-deformed modulation pattern; and

iteratively implementing the image processing method of claim 1 for the following images of the sequence.

9. (Currently Amended) A computer program product comprising a set of instructions for carrying out ~~one of the methods~~ a method as claimed in claim 1.

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10. (Currently Amended) A system for processing images of a sequence of MRI tagged images, comprising:

means for detecting tag points of these images according to a method as claimed in claim 1; and

means for displaying the results as a succession of images wherein tags are visible.

11. (Currently Amended) An MRI apparatus comprising:

means for acquiring sequences of MRI images from a site in a body; and
processing means including a system as claimed in Claim 10.